L Number	Hits	Search Text	DB	Time stamp
1	950037	immediate$	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/05/08 11:28
2	81835	seek	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/05/08 11:28
5	4093562	after	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/05/08 11:30
8	1853126	read or reading or fetch or fetching or fetched or buffer or buffering or buffered	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/05/08 11:30
9	46	immediate$ with seek with after with (read or reading or fetch or fetching or fetched or buffer or buffering or buffered)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/05/08 13:38

US-PAT-NO: 5267097

DOCUMENT-IDENTIFIER: US 5267097 A
See image for Certificate of Correction

TITLE: Information transfer control system having rotary storage unit which uses a pseudo address mark

-------- KWIC --------

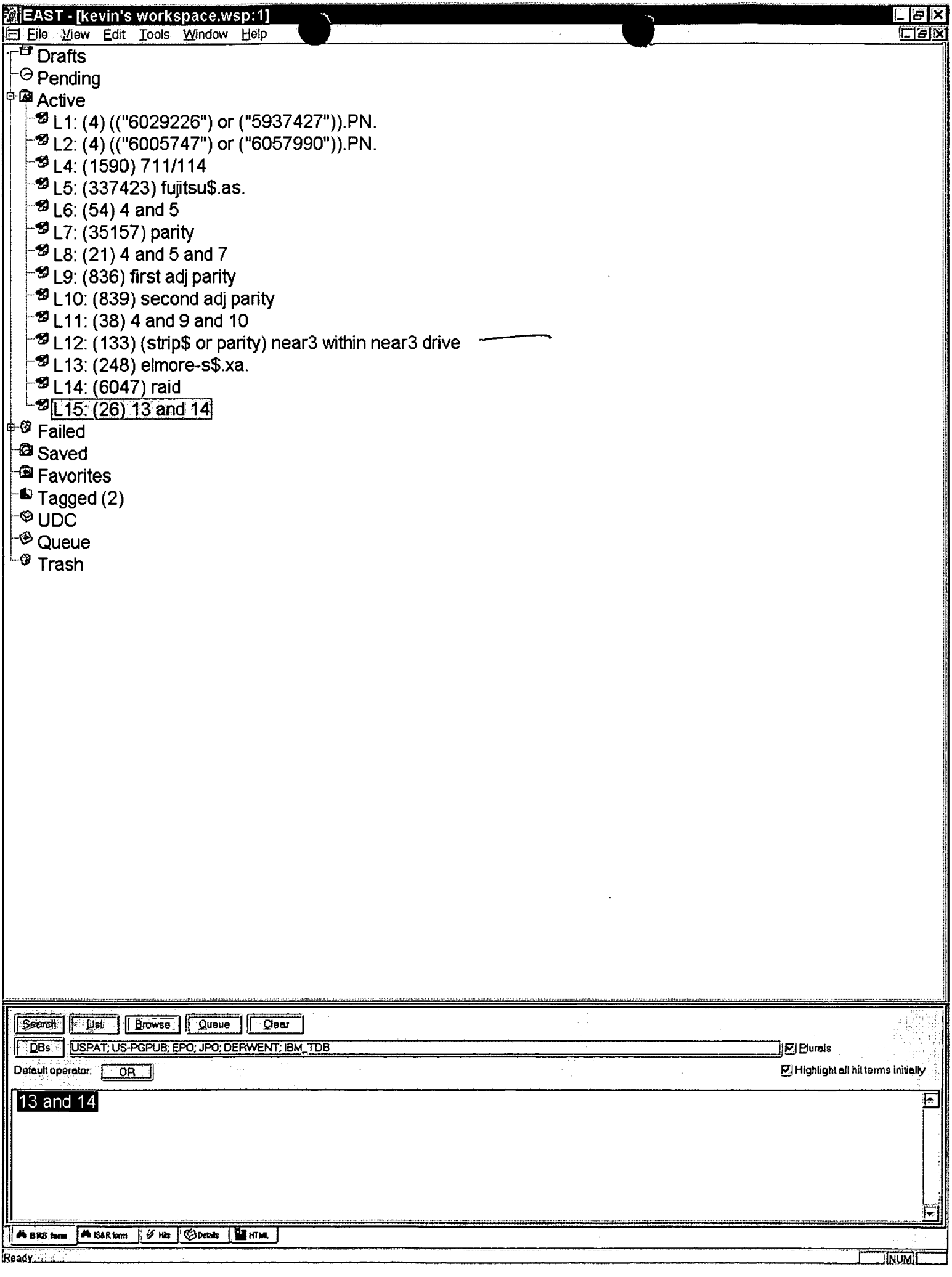
Brief Summary Text - BSTX (11):

Second, there is no description concerning means for reading out the information from the rotary storage unit without a read or write command from the controller. More specifically, in the conventional method, the read or write operation is not started immediately after a seek operation of the read /write section (a head) is completed so as to position or "on-track" the head on a target track but started when the head reaches a target sector after a read or write command for the target sector is received from the controller.

and following 9's

claim 1 + others

plural heads readily at same time from diff tracks in cyl


EAST - [kevin's workspace.wsp:1]
File View Edit Tools Window Help
Drafts
Pending
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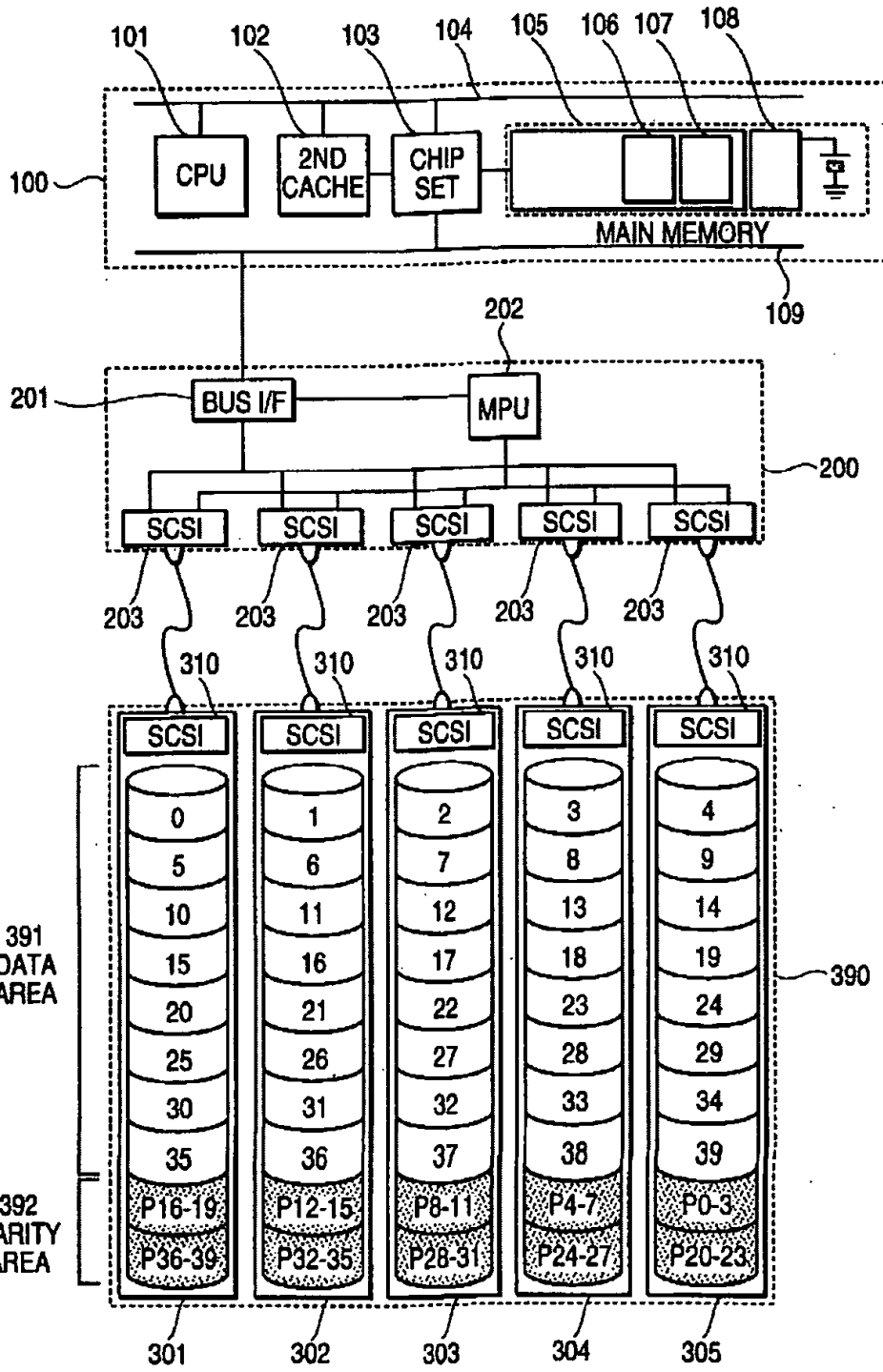
L1: (4) (("6029226") or ("5937427")).PN.
L2: (4) (("6005747") or ("6057990")).PN.
L4: (1590) 711/114
L5: (337423) fujitsu$.as.
L6: (54) 4 and 5
L7: (35157) parity
L8: (21) 4 and 5 and 7
L9: (836) first adj parity
L10: (839) second adj parity
L11: (38) 4 and 9 and 10
L12: (133) (strip$ or parity) near3 within near3 drive
L13: (248) elmore-s$.xa.
L14: (6047) raid
L15: (26) 13 and 14
Failed
Saved
Favorites
Tagged (2)
UDC
Queue
Trash
Search
Clear
DBs
USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB
Plurals
Default operator:
OR
Highlight all hit terms initially
13 and 14
Ready
NUM

FIG. 1



spiral sections read so far, the status of the buffer 27, e.g. the filling status of the buffer 27 and the rules stored in the memory 32. A next actuator jump is thus determined on a real-time basis.

[0060] It has to be noted that no particular pattern for the actuator jumps is employed, but a real-time analysis is made to determine where the next read and/or write position will be thereby taking the jump time of the actuator into account. For determining the next position a set of rules is employed. The algorithm also provides means to look ahead upon the next expected jump sequence to be performed by the actuator to optimize the playback or recording path. Thereby, the next jump is always dynamically calculated depending on a real-time analysis taking a plurality of rules into account.

[0061] In addition, the motor 22 is controlled by the microprocessor 30 in order to adopt the spinning rate to the status of the buffer 27. Therefore, the motor 22 is connected via an electrical line 33 with the microcontroller 30.

[0062] The apparatus according to FIG. 11 may be used for reading and/or writing data from/on an optical disk.

[0063] Although the embodiments according to FIGS. 1-11 have used an odd number of spots the number N of spots may be even as well as odd. Preferably, the distance between the spots is considered to remain fixed and given by the opto-mechanical construction of the reading/writing unit.

[0064] Summarized, there are several aspects behind the new proposal:

[0065] A first aspect is that data from a complete disk revolution (i.e., N spiral turns) is stored in the buffer right after a seek command has been performed; this has the advantage that linking of all N spiral turns can be immediately carried out and the user will only notice a delay due to the mechanical seek .

[0066] A second aspect is that the jump time of the actuator is always taken into account when a new jump decision is made during continuous playback.

[0067] A third aspect is that calculations in advance take place to position the N spots at that location which gives, at the same time maximum read out throughput and continuity in data flow.

[0068] A forth aspect is that a jump decision is made based on the following six rules: (i) the use of all N spots is encouraged all the time and has a higher priority in the decision process; (ii) no actuator jumps larger than 2N tracks are allowed; (iii) shorter spiral turns resulted from read gaps towards the inner radius are read out before longer spiral turns; (iv) if there is no gap to be decided for, inner actuator jumps have priority; (v) actuator jumps towards the inner as well as outer disk radius are allowed; and (vi) short spiral turns may be passed twice if this can be accomplished in less time than jumping to another location towards the outer disk radius.

[0069] The proposed playback or recording algorithm has the following

logical addresses into the physical addresses by the address converting means P stored in the ROM.

(13) Now, assuming that the number of tracks on one of the disc surfaces is Nt, and that the number of sectors in one track is Ns, as will be readily understood, the designated logical addresses can easily be converted into physical addresses by defining as the head number HN an integer part of a value obtained by dividing the value of the designated logical address by Nt.multidot.Ns, further defining as the track number TN an integer part of a value obtained by dividing the remainder of the division of the designated logical address by Nt.multidot.Ns by Ns and also defining the surplus of the second division as the sector number TS.

(14) The processor 20 issues the head number HN contained in the converted physical address as a head selection instruction HS and supplies it to the read/write circuit 6, and performs a so-called seek operation in which the processor 20 reads out the track number portion TN in the servo information SI via the servo information reading circuit 10, as is the case of a conventional disc storage unit, and moves the head 2 in the vicinity of the track with the track number TN in the converted physical address while issuing an instruction for operation and supplying it to the drive circuit 5 of the actuator 4. Immediately after completion of the seek operation a read /write instruction RW is supplied to the read /write circuit 6 in response to the instruction given by a computer (not shown) so as to begin a data read /write action.

(15) In this case, the processor 20 receives the magnitude of the vast signal obtained by reading the four servo information regions Sa to Sd in the servo information SI from the servo information reading circuit 10, as is the case of a conventional disc storage unit, and a calculates on off-track amount, and then while controlling the position of the head 2 via the actuator 4 in a closed loop control mode so that the off-track amount falls within a predetermined allowance, starts read/write operation in association with the internal bus 40 on the condition that the off-track amount becomes within the predetermined allowance.

(16) The reading or writing of data is usually performed such that the content of the data for one track is read or written continuously in one operation. However, in the present invention, the reading or writing data from or into a sector in a track is performed in a closed loop control mode with reference to preceding servo information on the same disc surface, resulting in that accurate reading out or writing can always be carried out even when the pitch between adjacent tracks is narrow and the mechanical precision of the head mechanism is not high. Of course, the reading or writing of data is carried out within the logical addresses designated by a computer (not shown) or until the last designated logical address is reached.

(17) When switching tracks from which data information is to be read from or written into while continuing the above-described operation, the processor 20 operates the actuator 4 to change the position of the head 2 by one intertrack pitch radially inwardly or outwardly and starts reading or writing data from or into a new track after confirming that the off-track amount has become within the predetermined allowance with reference to the servo information. As stated

US-PAT-NO: 5099368

DOCUMENT-IDENTIFIER: US 5099368 A

TITLE: Method of accessing a medium with low power consumption and a recording/reproducing apparatus for realizing the same

-------- KWIC --------

Brief Summary Text - BSTX (7):

However, in this standby system, after an adjacent track is sought as a destination track, the magnetic head accesses to this track for a read /write operation, access to a sector immediately upon completion of the seek operation may not be possible. As a result, the apparatus cannot access the medium until that sector makes one revolution. According to a format of tracks on the magnetic recording medium, gap areas GAP exist between sectors, with GAP 3, GAP 4, and GAP 0 normally existing between the head or first sector and the last or 36th sector. Each gap area corresponds to a rotational time of approximately 11 ms for a 1-MB magnetic recording medium, approximately 6.3 ms for a 2-MB type, and approximately 5.4 ms for a 4-MB type. The standby time (time for stopping the current supply from the power supplier) is set to, for example, around 8 ms (which is longer than the interval between step pulses) after a step pulse is output. Therefore, in a case of a low-recording density recording medium, such as a 1-MB type, data can be read from the first sector of an adjacent track subsequent to the last sector of a current track after the adjacent track is sought. However, when a relatively high-recording density recording medium, such as a 2-MB or 4-MB type is used, a wait state for one rotation occurs after an adjacent track is sought. Specifically, in the case where a file extending over two adjacent tracks is recorded on a magnetic recording medium, data is read out from the last sector of the first track by the magnetic head S1, then data is read out from the first sector of the second track by the magnetic head S0. In such a case, the FDC outputs one step pulse to the stepping motor to permit the associated magnetic head to seek the adjacent, second track after data is read out from the 36th sector of the first track. Then, the next data is read out from the first sector of the second track.

Brief Summary Text - BSTX (17):

As described above, according to this invention, a recording/reproducing apparatus for stopping the supply of power necessary for a read /write operation under given conditions such as a seek operation by a magnetic head, can ensure a standby function and can execute a read /write operation immediately after a seek operation when a consecutive data read /write operation is carrier out over adjacent two tracks. This can eliminate the otherwise probable generation of a waiting timing corresponding to one rotation of a magnetic recording medium after a seek operation, thus shortening the time for the read/write operation.

US-PAT-NO: 5033037

DOCUMENT-IDENTIFIER: US 5033037 A

TITLE: Track access control circuit of optical disk unit

-------- KWIC -------

Detailed Description Text - DETX (14):

The above-mentioned conventional seek operation, however, cannot establish a read /write enable state immediately after the lens seek control is switched to the fine control but requires a very long setting time.

Detailed Description Text - DETX (38):

FIGS. 8A to 8E are graphs for explaining the effect of the first embodiment of the present invention. In the figures, at time t1, the seek operation starts, and the seek operation ends at time t2. At the time t1, the lens is positioned at a starting position, and at the time t2, the lens reaches the target position of the track, as shown in FIG. 8A. During the seek period between the times t1 and t2, the lens seek target velocity Vt or the beam moving velocity V is generated as shown in FIG. 8D. According to the target velocity Vt or the beam moving velocity V, the velocity of the VCM positioner 16 is controlled, so that the velocity Vp of the moving VCM positioner 16 has only a slight rise delay and a fall delay with respect to the lens seek target velocity Vt as shown in FIG. 8E. As a result, the position of the positioner 16 follows rapidly the position of the lens as shown in FIG. 8B. Therefore, a fluctuation of the lens position sensor signal, i.e., the direction-position signal LPOS is produced only slightly just after the start of the seek and just after the end of the seek as shown in FIG. 8C. Accordingly, at the time of the switching from the lens seek control to the fine control again immediately after the time t2, the rotary arm 80 of the two-dimensional actuator. i.e., the object lens, is positioned substantially at the neutral position with respect to the positioner. Since a deviation from the neutral position is very small, a beam spot on the surface of a disk has an allowable roundness and, therefore, a read /write enable state is established immediately after the end of the seek at the time t2.

Detailed Description Text - DETX (57):

When the number of remaining tracks becomes zero in the lens seek control circuit 22, the end of the lens seek is judged in step S3 to open the switch SW3. Thereafter, in step S4, the switch SW2 is closed to start the track servo. Immediately after the seek operation is completed, a read /write enable state is established without waiting for a particular settling time.

PAT-NO: JP401182970A

DOCUMENT-IDENTIFIER: JP 01182970 A

TITLE: MAGNETIC DISK DEVICE

--------- KWIC --------

Abstract Text - FPAR (1):

PURPOSE: To constantly execute a reading action or a writing action immediately after the completion of a seek action by providing a means to search an objective record and a means to temporarily store read data or data to be written.

Abstract Text - FPAR (2):

CONSTITUTION: A record number comparison part 29 compares data read out from a magnetic disk medium 30 by a magnetic disk medium reading part 26 and data stored in a record number storage part 28. When the search action of the objective record is completed by this comparison, a data transfer controlling part 25 starts writing into a data temporary storage part 24 data read by the magnetic disk medium reading part 26 from the magnetic medium 30. The data transfer controlling part 25 transfers the data to be stored from the data temporary storage part 24 to a magnetic disk medium writing part 27 and starts writing into the magnetic disk medium 30. Thus, the reading action or the writing action can be executed immediately after the completion of the seek action.

⑲日本国特許庁(JP)　⑪特許出願公開

⑫公開特許公報(A)　平1-182970

⑤Int.Cl.⁴　識別記号　庁内整理番号　⑬公開　平成1年(1989)7月20日
G 11 B 20/10　A-6733-5D

審査請求　未請求　請求項の数 1　(全4頁)

⑭発明の名称　磁気ディスク装置

⑳特　願　昭63-6663
㉒出　願　昭63(1988)1月14日

㉑発明者　市川　文男　東京都港区芝5丁目33番1号　日本電気株式会社内
㉑出願人　日本電気株式会社　東京都港区芝5丁目33番1号
㉔代理人　弁理士　井ノ口　壽

明　細　書

1.発明の名称

磁気ディスク装置

2.特許請求の範囲

データを記憶する磁気ディスク媒体と、前記磁気ディスク媒体にデータを書込む磁気ディスク媒体書込み部と、前記磁気ディスク媒体からデータを読出す磁気ディスク媒体読出し部を有する磁気ディスク装置において、前記磁気ディスク媒体書込み部に入力すべきデータあるいは前記磁気ディスク媒体読出し部から出力されたデータを一時格納するデータ一時貯蔵部と、磁気ディスク制御装置から与えられた読出し、あるいは書込みレコード番号を記憶するレコード番号貯蔵部と、前記レコード番号貯蔵部の出力と前記磁気ディスク読出し部の出力を比較し、サーチされるべきレコードのレコード番号を識別するレコード番号比較部と、前記レコード番号比較部の出力により前記磁気ディスク媒体読出し部から前記データ一時貯蔵部へのデータの転送と前記データ一時貯蔵部から前記磁気ディスク媒体書込み部へのデータの転送を制御するデータ転送制御部を有することを特徴とする磁気ディスク装置。

3.発明の詳細な説明

(産業上の利用分野)

本発明は磁気ディスク装置に関し、特に磁気ディスク媒体へのデータの書込み時あるいは磁気ディスク媒体からのデータの読出し時の回転待ち動作が改善された磁気ディスク装置に関する。

(従来の技術)

磁気ディスク装置において、磁気ヘッドが所定のトラックまたはシリンダに達した後、書込みまたは読出しをすべきセクタが磁気ヘッド位置まで回転してくるまでの回転待ち時間を経た後、データの書込みあるいは読出しの動作が行なわれる。

この回転待ちが終つた時点を知るため、従来

PAT-NO: JP401146167A

DOCUMENT-IDENTIFIER: JP 01146167 A

TITLE: DISK DEVICE

-------- KWIC -------

Abstract Text - FPAR (1):

PURPOSE: To minimize latency time by providing an annular track buffer and a sector number detector, which detects a sector number from hard-sector or soft-sector information after completion of seek, to permit recording and reproducing immediately after completion of seek processing.

⑲日本国特許庁（JP）　⑪特許出願公開

⑫公開特許公報（A）　平1－146167

⑤Int.Cl.⁴	識別記号	庁内整理番号	⑬公開
G 11 B 20/10		A－6733－5D	平成1年(1989)6月8日

審査請求　未請求　発明の数 1　（全6頁）

⑭発明の名称　ディスク装置

⑳特　願　昭62－305059
㉒出　願　昭62(1987)12月1日

㉑発明者　神門　俊和　大阪府門真市大字門真1006番地　松下電器産業株式会社内
㉑発明者　松川　茂　大阪府門真市大字門真1006番地　松下電器産業株式会社内
㉑出願人　松下電器産業株式会社　大阪府門真市大字門真1006番地
㉔代理人　弁理士　中尾　敏男　外1名

明　細　書

1．発明の名称

ディスク装置

2．特許請求の範囲

(1) シーク動作を完了した後にハードセクタあるいはソフトセクタ情報からセクタ番号を検出するセクタ番号検出手段と、転送の許可されているセクタバッファをリング状に連結して成るリング状トラックバッファと、前以って設定される転送許可情報とセクタ番号検出手段から送られてくるセクタ番号情報とから転送の可否を判断し、リング状トラックバッファに許可信号としてこれを送る機能を有する転送許可確認手段と、前記許可信号を参照して記録再生を行う記録再生手段とを備え、記録再生の対象となるセクタが確認された時はそのセクタから転送を開始することを特徴とするディスク装置。

(2) リング状トラックバッファは、一時記憶装置と、セクタアドレス更新装置と、セクタ内アドレスカウンタを備え、指定された転送開始セクタ番号と転送終了セクタ番号間でリング状のメモリを形成し、かつ転送開始セクタ番号を任意に設定できることを特徴とする特許請求の範囲第(1)項記載のディスク装置。

3．発明の詳細な説明

産業上の利用分野

本発明は、処理速度の向上を図るために一時記憶装置（バッファ）を備えたディスク装置に関するものである。

従来の技術

ディスク装置の処理能力を向上させる方法として、トラックバッファを用いる方法が知られている。トラックバッファを使用するとデータ転送速度の遅いホストコンピュータとの接続が容易になり、またインターリーブ処理が不用となるなどの特徴を持つ。さらに、エラー訂正の為の処理に要する時間をディスクに対する記録再生時の転送速度とは無関係に設うことができ、設計が容易になるなどの利点もある。処理能力を向上させる他の方法として、デュアルバッファ構成をとり並列処

DERWENT-ACC-NO: 2000-590861

DERWENT-WEEK: 200056

TITLE: Information reproducing apparatus for compact disc read only memory, searches data corresponding to objective selector from data buffered in memory, based on which start position of objective sector is determined

--------- KWIC --------

Basic Abstract Text - ABTX (1):

NOVELTY - Data read from disc immediately after completion of seek operation, is decoded and buffered in a memory (13). Simultaneously, data corresponding to objective sector (15) is searched from memory from which start position of objective sector is determined and regisitered in the memory.

(19)日本国特許庁（ＪＰ）　(12)**公開特許公報**（Ａ）　(11)特許出願公開番号
特開2000－235781
（P2000－235781A）
(43)公開日　平成12年８月29日(2000.8.29)

(51)Int.Cl'	識別記号	ＦＩ		テーマコード'（参考）
Ｇ１１Ｂ　27/10		Ｇ１１Ｂ　27/10		５Ｄ０４４
7/005		7/00	６３６Ｚ	５Ｄ０７７
20/10		20/10	Ｂ	５Ｄ０９０
		27/10	Ａ	

審査請求　未請求　請求項の数１　ＯＬ　（全５頁）

(21)出願番号　特願平11－35099

(22)出願日　平成11年２月15日(1999.2.15)

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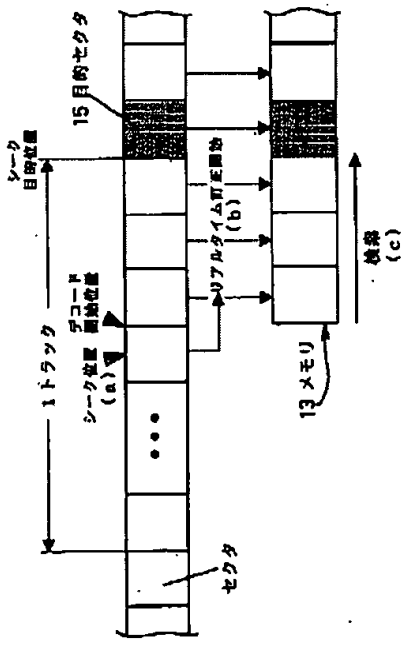
(74)代理人　100068087
弁理士　森本　義弘

Ｆターム(参考)　5D044 BC02 CC04 DE03 DE12 DE38 DE96 FC10 FG19 FG24
5D077 AA28 CA02 CB04 DC10 EA11
5D090 AA01 CC04 DD03 DD05 FF21 FF25 FF30 FF49 GG28 GG36 HH01

(54)【発明の名称】　情報再生装置

(57)【要約】
【課題】　ディスク記録媒体からデータを再生する際に、その目的とするセクタへの平均アクセス時間を、従来に比べて短縮することができ、データの再生速度を高速化することができる情報再生装置を提供する。
【解決手段】　シーク動作完了直後から、リアルタイム訂正モードによりデコード及びメモリ１３へのバッファリングを開始し、それと並行してメモリ１３から読み出しの際の目的とするセクタ１５を検索し、メモリ１３内部での目的セクタ１５の開始位置を登録する。



L Number	Hits	Search Text	DB	Time stamp
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2	4	(("6029226") or ("5937427")).PN.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/05/08 09:21
3	19618	piezo adj electric	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/05/08 09:58
4	1425270	head	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/05/08 09:58
5	728618	fine	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/05/08 09:58
6	69	(piezo adj electric) same head same fine	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/05/08 09:58

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  - L2: (4) (("6029226") or ("5937427")).PN.
  - L3: (19618) piezo adj electric
  - L4: (1425270) head
  - L5: (728618) fine
  - L6: (69) 3 same 4 same 5
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- Favorites
- Tagged (8)
- UDC
- Queue
- Trash

	U		Document ID	Issue Date	Inventor	Current OR	Pages	
1	☐	☑	US 20020039261 A1	20020404	Sividasan, Kodikkunnathukulangara et al.	360/294.4	13	H s
2	☐	☑	US 20020135913 A1	20020926	Yanagimoto, Yoshiyuki	360/31	43	M G
3	☐	☑	US 20010036035 A1	20011101	Morris, John C. et al.	360/78.05	10	S e
4	☐	☑	US 6545836 B1	20030408	Ioannou, Petros A. et al.	360/77.06	42	S c
5	☐	☑	US 6490121 B1	20021203	Pruett, David C. et al.	360/78.09	15	A e
6	☐	☑	US 6295184 B1	20010925	Takekado, Shigeru	360/294.4	19	H a
7	☐	☑	US 5521778 A	19960528	Boutaghou, Zine-Eddine et al.	360/264.5	8	D v
8	☐	☑	US 4858040 A	19890815	Hazebrouck, Henry B.	360/78.05	8	E a

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United States Patent [19]

Hazebrouck

[11] **Patent Number: 4,858,040**

[45] **Date of Patent: Aug. 15, 1989**

[54] **BIMORPH ACTUATOR FOR A DISK DRIVE**

[75] Inventor: **Henry B. Hazebrouck**, Sunnyvale, Calif.

[73] Assignee: **Ampex Corporation**, Redwood City, Calif.

[21] Appl. No.: **89,097**

[22] Filed: **Aug. 25, 1987**

[51] Int. Cl.[4] G11B 5/55; G11B 5/596

[52] U.S. Cl. 360/78.05; 360/77.02; 360/78.12; 360/109

[58] Field of Search 360/75, 77, 78, 107, 360/109, 106, 77.01, 77.02, 77.03, 77.04, 77.05, 77.06, 77.07, 77.08, 77.11, 77.16, 77.12, 78.01, 78.02, 78.04, 78.05, 78.12

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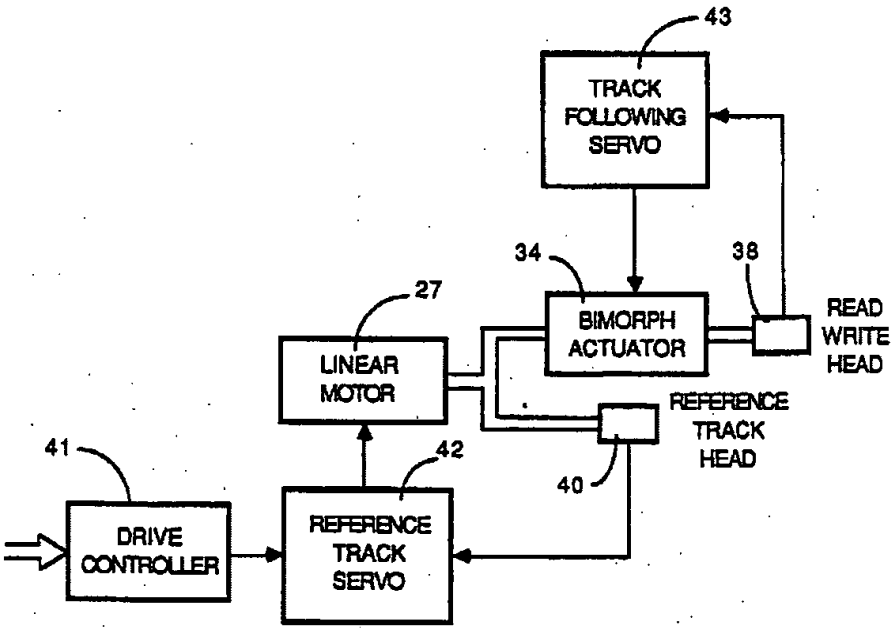
54-49108	4/1979	Japan	360/109

Primary Examiner—Aristotelis M. Psitos
Assistant Examiner—Steven R. Garland
Attorney, Agent, or Firm—Harry G. Thibault; Richard P. Lange

[57] **ABSTRACT**

A movable actuator supporting a stacked assembly of read/write heads for unitary movement adjacent respective disk surfaces of a disk drive mechanism, the movable actuator incorporating a series of secondary actuators, one for each head, each secondary actuator including a bimorph member with piezoelectric properties, and capable of extremely precise movements for secondary positioning.

4 Claims, 3 Drawing Sheets



US-PAT-NO: 4858040

DOCUMENT-IDENTIFIER: US 4858040 A

TITLE: Bimorph actuator for a disk drive

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Brief Summary Text - BSTX (10):

In the present invention, the piezo-electric effect produced by certain materials is used to advantage in the design of an improved actuator for a disk drive to produce the small, precise and controlled movements required for the improved positional alignment of individual read/write heads by the improved actuator. In the present invention the secondary actuator which is used to positionally align an individual read/write head with respect to a selected track on a respective disk surface includes a bimorph support member which has the same properties as a piezo-electric material and which bends when a voltage is applied thereto. Thus, a controllable electrical input can produce a small, measurable and precise mechanical movement in the bimorph support member and its associated head to align the head with its associated track with precision and accuracy. A primary actuator comprises a sectioned arm having at one end an electromagnetic or similar driving apparatus and at an opposite end multiple pairs of read/write heads, each head mounted on a bimorph support member of each secondary actuator to be fine positioned to lie adjacent a respective disk surface of the disk drive apparatus for read/write output/input. The bimorph support member or secondary actuator is supported at its opposite ends by the support structure of the actuating system. The conductive coating on the bimorph support member is etched and reconnected such that an applied voltage will move the member forward. The read/write head attached to the center of the bimorph support member also moves when a voltage is applied to the member.

US005521778A

United States Patent [19]

Boutaghou et al.

[11] **Patent Number: 5,521,778**

[45] **Date of Patent: May 28, 1996**

[54] **DISK DRIVE WITH PRIMARY AND SECONDARY ACTUATOR DRIVES**

[75] Inventors: **Zine-Eddine Boutaghou; Hal H. Ottesen**, both of Rochester, Minn.

[73] Assignee: **International Business Machines Corporation**, Armonk, N.Y.

[21] Appl. No.: **298,509**

[22] Filed: **Aug. 30, 1994**

[51] **Int. Cl.**[6] **G11B 5/55**; G11B 5/56

[52] **U.S. Cl.** **360/106**; 360/109

[58] **Field of Search** 360/106, 109, 360/107

[56] **References Cited**

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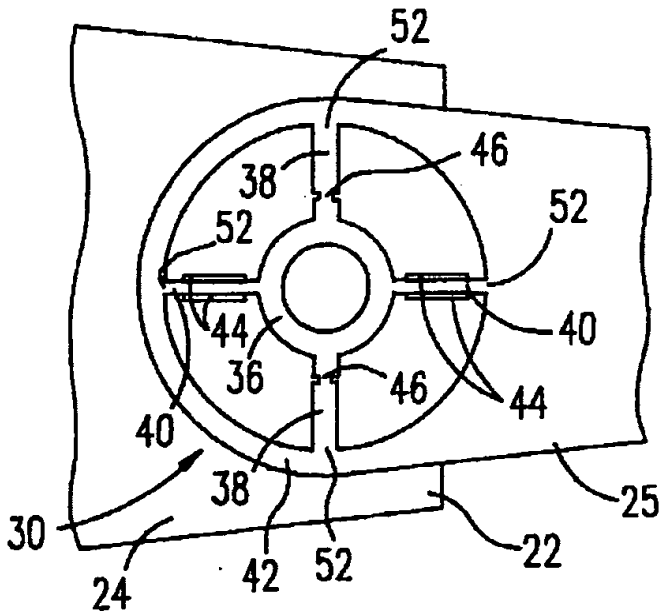
Primary Examiner—Robert S. Tupper
Assistant Examiner—David D. Davis
Attorney, Agent, or Firm—Laurence R. Letson

[57] **ABSTRACT**

A secondary actuator for increased positional resolution of a read/write head for a DASD is disposed on the distal end of an actuator arm and acts to pivotally move the load beam about the attachment axis. The actuator is comprised of a ring structure on the end of the load beam with the ring structure attached to a central hub through a plurality of spokes. The central hub is fixedly attached to the distal end of the actuator arm for the DASD. Relative motion between the actuator arm and the load beam is accomplished by causing a deflection in one or more of the spokes. The deflection may be caused by piezo-electric transducer elements which are attached to the sides of at least two spokes. Signals sent to the piezo-electric transducer elements will cause bending of the piezoelectric transducer elements and the attached spoke and thus rotationally displace the junction of the spoke and the ring about the central hub. This arrangement permits increasing the fine resolution of the recording tracts on a DASD disk by accommodating the stiction forces which limit the resolution of the actuator and eliminating stiction forces as a factor for the secondary actuator.

20 Claims, 2 Drawing Sheets



US-PAT-NO: 5521778

DOCUMENT-IDENTIFIER: US 5521778 A

TITLE: Disk drive with primary and secondary actuator drives

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Abstract Text - ABTX (1):

A secondary actuator for increased positional resolution of a read/write head for a DASD is disposed on the distal end of an actuator arm and acts to pivotally move the load beam about the attachment axis. The actuator is comprised of a ring structure on the end of the load beam with the ring structure attached to a central hub through a plurality of spokes. The central hub is fixedly attached to the distal end of the actuator arm for the DASD. Relative motion between the actuator arm and the load beam is accomplished by causing a deflection in one or more of the spokes. The deflection may be caused by piezo-electric transducer elements which are attached to the sides of at least two spokes. Signals sent to the piezo-electric transducer elements will cause bending of the piezoelectric transducer elements and the attached spoke and thus rotationally displace the junction of the spoke and the ring about the central hub. This arrangement permits increasing the fine resolution of the recording tracts on a DASD disk by accommodating the stiction forces which limit the resolution of the actuator and eliminating stiction forces as a factor for the secondary actuator.

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  - L2: (4) (("6029226") or ("5937427")).PN.
  - L3: (19618) piezo adj electric
  - L4: (1425270) head
  - L5: (728618) fine
  - L6: (69) 3 same 4 same 5
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US006295184B1

(12) **United States Patent**
Takekado

(10) **Patent No.: US 6,295,184 B1**
(45) **Date of Patent: Sep. 25, 2001**

(54) **HEAD ACTUATOR MECHANISM AND MAGNETIC DISK DRIVE INCLUDING THE SAME**

(75) Inventor: **Shigeru Takekado**, Tokyo (JP)

(73) Assignee: **Kabushiki Kaisha Toshiba** (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/156,299**

(22) Filed: **Sep. 17, 1998**

(30) **Foreign Application Priority Data**

Sep. 18, 1997 (JP) 9-253703
May 15, 1998 (JP) 10-133321

(51) **Int. Cl.**[7] **G11B 21/10**
(52) **U.S. Cl.** **360/294.4**; 360/78.05
(58) **Field of Search** 360/78.05, 294.3, 360/294.4, 75, 78.12

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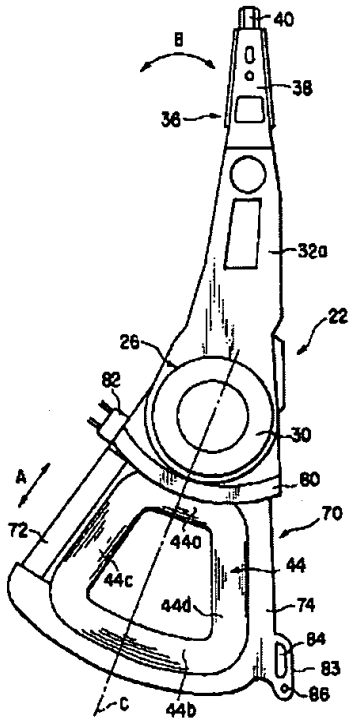
Primary Examiner—David Hudspeth
Assistant Examiner—James L. Habermehl
(74) *Attorney, Agent, or Firm*—Gray Cary Ware & Freidenrich LLP

(57) **ABSTRACT**

A driving section of a head actuator mechanism rotatably supporting a magnetic disk includes a voice coil, and a piezo-electric element for cutting off a resonance resulting from a drive of the voice coil. The driving section is arranged on a side opposite to an arm across a rotational axis of the head actuator mechanism. The voice coil and the piezo-electric element are held by a holding frame which is molded of a resin integrally with these voice coil and piezo-electric element.

5 Claims, 10 Drawing Sheets



on the basis of a disk, and then, the actuator is ecisely when positioning the magnetic head. The hindrance is a mechanical vibration generated in components such as the support arm constituting the actuator, or the like.

(12) The mechanical vibration of the head actuator mechanism includes a resonance peak due to a rotary spring characteristic of ball bearings provided in the actuator body, and peaks resulting from resonance modes of the head actuator mechanism itself.

(13) The major resonance mode of the head actuator mechanism is estimated to be generated by a mode wherein the driving coil of the VCM and the coil holding frame holding the driving coil are deformed in a rotating (circumferential) direction of the magnetic disk when driving the head actuator mechanism. Further, the major resonance mode resulting from the structure of the head actuator mechanism itself is a high frequency of 1 kHz or more, and affects the servo system for carrying out a positioning control of the magnetic head. This is a factor of malfunction such as an off-track error.

(14) More specifically, the vibration of the head actuator mechanism is a factor of lowering a positioning accuracy of the magnetic head, and in particular, causes a problem of lowering a recording density (track density) in a track direction.

(15) Therefore, in order to prevent a bad influence to the servo system as much as possible, there are required to eliminate the mechanical vibration of the head actuator mechanism as much as possible and to provide a design or device for increasing a resonance frequency of the support arm or the like.

(16) Further, there is a need of decreasing an off-track resulting from vibration applied from the outside of the HDD, vibration generated from the spindle motor and others in the HDD and the like. In this case, a gain cross frequency, at which gain crosses 0 dB and which is one of the open loop characteristic of the servo system, must be increased as much as possible.

(17) A method of increasing the gain cross frequency in the servo system has been disclosed in Jpn. Pat Appln. KOKAI publication No. 51-36924, or in a document "Track follow-up control of magnetic drive 2-stage access servo system" (VOl. J75, No. 11, pages 653 to 662) published by Institute of electronic information and communication, for example.

(18) In the aforesaid Publication and document, there has been proposed a system which is provided with a main actuator (VCM) for integrally moving a plurality of magnetic heads with a long stroke, and an auxiliary actuator (composed of a piezo-electric element) for finely moving the magnetic heads independently from each other.

US-PAT-NO: 6490121

DOCUMENT-IDENTIFIER: US 6490121 B1

TITLE: Accelerated servo control calculations method and apparatus for a disc drive

-------- KWIC --------

Detailed Description Text - DETX (49):

The observer 204 then moves to decision step 288 and decides whether the dimensional change the piezo electric transducer 212 attained coincides with the expected dimensional change. If the dimensional change achieved by the piezoelectric transducer member 210 coincides with the expected dimensional change of the piezoelectric transducer member 210, the requested change in head position is deemed to having been achieved. The servo engine 184 of the disc drive 100 proceeds to HSA 128 alignment step 298. Completing process step 298, the servo engine 184 returns to the track follow mode of process step 276. If the dimensional change achieved the piezo electric transducer 212 fails to attain the expected dimensional change of the piezoelectric transducer member 210, the observer 204 provides a correction voltage to summing junction 196 to be used in process step 290 to modify the voltage of the piezo plant 168. This voltage application, verification and voltage reapplication mode of process steps 282 through 290 continues under the track following mode of the disc drive 100 through its low pass response transfer function and serves as a fine mode track following control system for the disc drive 100.

US-PAT-NO: 6545836

DOCUMENT-IDENTIFIER: US 6545836 B1

TITLE: Servo control apparatus and method using absolute value input signals

-------- KWIC --------

Brief Summary Text - BSTX (17):

The read and write head 22 is a small assembly provided on the end of an arm or transducer assembly 24 that moves the head 22 over the storage surface 10. The transducer assembly may move the head 22 by rotation, by translation or by a combination of rotations and translations. For example, many present drives provide larger movements by rotating the transducer assembly about a pivot on the end of the transducer assembly opposite that of the head 22. Additional adjustments may be accomplished using fine translations, which might be accomplished, for example, using piezo-electric elements. In general, the mechanical rotational and translational movements of the head 22 are preferably accomplished under servo control using, for example, voice coil motors or other compact, fast response systems. The read and write head 22 of the transducer assembly is typically not rigidly attached to the transducer assembly. Rather, the read and write head is preferably mounted on a slider coupled to the transducer assembly through a flexible assembly. Typically the slider is designed to "fly" on an air bearing over the data storage surface created between the shaped undercarriage of the slider and the disk.

DOCUMENT-IDENTIFIER: US 20010036035 A1

TITLE: Single-sided unipolar device driver for a piezoelectric transducer in a disc drive

--------- KWIC --------

Detail Description Paragraph - DETX (11):

[0025] In a preferred embodiment the bias signal 158 is representative of a bias voltage signal, the single-sided unipolar driver 160 is a single-sided unipolar PZT driver 160 and the micro-actuator 130 is a bipolar piezo electric transducer 130 (hereafter PZT 130). The PZT 130 is used for fine position-control of the read/write head 118 relative to the data track 120 and to maintain the mechanical position of the PZT 130 relative to the selected data track 120, based on the voltage level received from the single-sided unipolar PZT driver 160. The single-sided unipolar PZT driver 160 maintains a voltage level used to drive the PZT 130 in the form of a position voltage, until the positioning voltage is updated. Once the position voltage is updated, the single-sided unipolar piezo driver 160 induces a change in mechanical position of the PZT 130, relative to the selected data track 120, which changes the alignment of the selected read/write head 118 relative to the selected data track 120.

DOCUMENT-IDENTIFIER: US 20020039261 A1

TITLE: Head suspension assembly for magnetic disk drives

-------- KWIC --------

Detail Description Paragraph - DETX (5):

[0035] The inner and outer rings 44,46 are of piezo electric (electrostrictive) material and are axially polarized in opposite directions such that one tries to contract whilst the other tries to expand under the influence of an applied electric field. The resulting strains manifest in the form of an expansion/contraction of the body 32 thereby changing gap 42. If first end 34 is coupled to a (relatively) proximal part of the head suspension assembly (either mounting region 14 or flexible coupling 18 depending upon where the microactuator is mounted) and second end 38 is coupled to a (relatively) distal part of the head suspension assembly, controlling the size of the gap 42 will produce fine tracking movement of the head slider 20.

DOCUMENT-IDENTIFIER: US 20020135913 A1

TITLE: Measuring apparatus and measuring method for measuring performance characteristics of recording unit including circular recording medium

-------- KWIC -------

Detail Description Paragraph - DETX (17):

[0106] The above-mentioned head positioning control mechanism is mainly divided into two sections. One is a rough positioning mechanism comprised of an X-Y stage or the like and another one is a fine positioning mechanism which is constituted by a piezo-electric stage 9a shown in FIG. 19, the micro actuator (MA) 6 shown in FIGS. 16 and 17 and the like. Although the rough positioning mechanism is not shown since it has no direct relation to the present invention, the rough positioning mechanism is controlled by the main controller 20. The head position control mechanism 13 shown in FIG. 1 indicates the above-mentioned fine positioning mechanism, and it operates to finely adjust the position of a magnetic head 4 required for measurement of track profile characteristics and so on. The operation of the head position control mechanism 13 is controlled by the head position controlling module 33. In addition, the operation of micro actuator 6 is controlled by the MA position controlling module 34. In this case, the magnetic head 4 is provided at the tip of the suspension 8 via a support member 7 and the micro actuator 6 as shown in FIG. 16, and finely moves in the right and left directions of FIG. 17 (which is indicated by a direction of an arrow 101: this is the direction substantially perpendicular to a circumferential direction of coaxial tracks on the circular hard disk 1) by the operation of the micro actuator 6 as shown in FIG. 17. In this case, the magnetic head 4 is supported so as to move in a radial direction, in a direction perpendicular to the radial direction and approximately in a vertical direction relative to the track of the hard disk 1 so that the magnetic head 4 can be electromagnetically coupled with the surface of the hard disk 1 in a non-contact manner. The position of the magnetic head 4 is controlled by the above-mentioned head position control mechanism 13 and the micro actuator 6 connected to the magnetic head 4.